EFFECT OF NONMAGNETIC PbO NANOPARTICLES ADDITION ON THE MICROSTRUCTURE AND ELECTRICAL TRANSPORT PROPERTIES OF $YBa_2Cu_3O_7$

STEPHANIE KEONG WEI SAN

Thesis submitted in fulfillment of the requirements
for the award of the degree of
Bachelor of Applied Science (Honor) Material Technology

Faculty of Industrial Sciences & Technology
UNIVERSITI MALAYSIA PAHANG

DECEMBER 2016

ABSTRACT

Superconductors are materials that show zero resistance when subjected to temperature under its critical temperature. Yttrium Barium Copper Oxide (YBCO) was prepared using solid state reaction method by grinding, sintering and finally pressing the samples into pellets. The objective of the research ws to study the change in (i) microstructure and (ii) electrical transport properties of YBCO with the addition of 0.00 wt%, 0.01 wt%, 0.02 wt%, 0.03 wt% and 0.04 wt% nonmagnetic PbO nanoparticles, as well as to develop a laboratory scale method in determining the electrical properties of YBCO at liquid nitrogen temperature. The presence of superconductivity was tested and confirmed when the samples was allowed to levitate above a row of Neodymium magnet and the sample with 0.04 wt% PbO nanoparticle showed the longest levitation time. From the results obtained from the X-ray diffraction, it was noted that there was minimal changes to the microstructure and composition of the superconductor when the PbO nanoparticle was added to them. A four point probe was developed to test the critical temperature of the YBCO superconductor. The results obtained does not fulfil the expected results as the critical temperature obtained for the added sample is lower than that of the referenced results which is 90 K.

ABSTRAK

Superkonduktor adalah bahan-bahan yang menunjukkan rintangan sifar apabila diletakkan suhu di bawah suhu kritikal. Yttrium Barium Copper Oxide (YBCO) telah disediakan dengan menggunakan kaedah tindak balas keadaan pepejal dengan mengisar, menyintar dan akhirnya menekan sampel ke dalam pelet. Objektif penyelidikan adalah untuk mengkaji perubahan dalam (i) mikrostruktur dan (ii) ciri-ciro elektrik YBCO dengan tambahan 0.00 wt%, 0.01 wt%, 0.02 wt%, 0.03 wt% dan 0.04 wt% nanozarah PbO , serta untuk mewujudkan kaedah skala makmal untuk menentukan ciri-ciri elektrik YBCO pada suhu nitrogen cecair. Kehadiran kesuperkonduksian telah diuji dan disahkan apabila sampel dibiarkan terapung di atas deretan magnet Neodymium dan sampel dengan 0.04 wt% PbO nanozarah menunjukkan masa pengangkatan paling lama. Daripada keputusan yang diperolehi daripada pembelauan sinar-X, didapati bahawa terdapat perubahan yang minimum kepada mikrostruktur dan komposisi superkonduktor apabila nanozarah PbO telah ditamba. Penduga empat titik telah diwujudkan untuk menguji suhu kritikal superkonduktor YBCO. Keputusan yang diperolehi tidak memenuhi hasil yang diharapkan kerana suhu kritikal yang diperolehi bagi sampel yang telah ditambah dengan nanozarah adalah lebih rendah daripada keputusan yang dirujuk iaitu 90 K.